This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-6 + 4i)(9 - 3i)$$

The solution is $-42 + 54i$, which is option C.

A. $a \in [-42, -38]$ and $b \in [-56, -50]$

$-42 - 54i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-68, -58]$ and $b \in [16, 19]$

$-66 + 18i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-42, -38]$ and $b \in [52, 59]$

* $-42 + 54i$, which is the correct option.

D. $a \in [-68, -58]$ and $b \in [-18, -16]$

$-66 - 18i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-55, -49]$ and $b \in [-16, -6]$

$-54 - 12i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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2. Simplify the expression below and choose the interval the simplification is contained within.

$$20 - 17^2 + 7 \div 18 * 19 \div 8$$

The solution is -268.076, which is option D.

A. $[-269.87, -268.41]$

-268.997, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[309.82, 310.51]$

309.924, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[308.54, 309.06]$

309.003, which corresponds to two Order of Operations errors.

D. $[-268.96, -267.02]$

* -268.076, this is the correct option

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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3. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{12}{14} + \sqrt{-9}i$$

The solution is Rational, which is option D.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

D. Rational

* This is the correct option!

E. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$-\sqrt{\frac{225}{121}} + 16i^2$$

The solution is Rational, which is option D.

A. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

D. Rational

* This is the correct option!

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{63 - 22i}{-1 + 3i}$$

The solution is $-12.90 - 16.70i$, which is option A.

A. $a \in [-13, -12.5]$ and $b \in [-17.5, -16]$

* $-12.90 - 16.70i$, which is the correct option.

B. $a \in [-64.5, -62.5]$ and $b \in [-9, -5.5]$

$-63.00 - 7.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-13, -12.5]$ and $b \in [-169, -166]$

$-12.90 - 167.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-130, -128]$ and $b \in [-17.5, -16]$

$-129.00 - 16.70i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [-0.5, 1.5]$ and $b \in [20, 22.5]$

$0.30 + 21.10i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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6. Simplify the expression below and choose the interval the simplification is contained within.

$$20 - 19 \div 14 * 6 - (16 * 17)$$

The solution is -260.143, which is option D.

A. $[-70.43, -63.43]$

-70.429, which corresponds to not distributing a negative correctly.

B. $[-255.23, -247.23]$

-252.226, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[291.77, 293.77]$

291.774, which corresponds to not distributing addition and subtraction correctly.

D. $[-262.14, -258.14]$

* -260.143, which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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7. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(9 - 6i)(2 - 8i)$$

The solution is $-30 - 84i$, which is option B.

A. $a \in [-34, -28]$ and $b \in [81, 88]$

$-30 + 84i$, which corresponds to adding a minus sign in both terms.

B. $a \in [-34, -28]$ and $b \in [-86, -81]$

* $-30 - 84i$, which is the correct option.

C. $a \in [66, 68]$ and $b \in [60, 67]$

$66 + 60i$, which corresponds to adding a minus sign in the second term.

D. $a \in [66, 68]$ and $b \in [-64, -55]$

$66 - 60i$, which corresponds to adding a minus sign in the first term.

E. $a \in [17, 23]$ and $b \in [48, 55]$

$18 + 48i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{45 - 66i}{7 - i}$$

The solution is $7.62 - 8.34i$, which is option C.

A. $a \in [4, 6]$ and $b \in [-10.5, -9.5]$

$4.98 - 10.14i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [5.5, 7]$ and $b \in [65, 66.5]$

$6.43 + 66.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [6.5, 8]$ and $b \in [-9, -6.5]$

* $7.62 - 8.34i$, which is the correct option.

D. $a \in [380, 382]$ and $b \in [-9, -6.5]$

$381.00 - 8.34i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

E. $a \in [6.5, 8]$ and $b \in [-417.5, -416]$

$7.62 - 417.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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9. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{-715}{5}}$$

The solution is Not a Real number, which is option D.

A. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

B. Irrational

These cannot be written as a fraction of Integers.

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

D. Not a Real number

* This is the correct option!

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{143}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{38025}{169}}$$

The solution is Whole, which is option E.

A. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

D. Irrational

These cannot be written as a fraction of Integers.

E. Whole

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 195.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.
